Broccoli

Recommendations for Maintaining Postharvest Quality

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Produce Facts

MATURITY INDICES

Head diameter and compactness; all florets (beads) should be closed.

QUALITY INDICES

Good quality broccoli should have dark or bright green closed florets, and the head should be compact (firm to hand pressure), with a cleanly cut stalk of the required length. There should be no yellow florets and there should be no discoloration on the stem bracts.

OPTIMUM TEMPERATURE AND RELATIVE HUMIDITY

Low temperature is extremely important to achieve adequate shelf-life in broccoli. A temperature of 0°C (32°F) with >95% RH is required to optimize broccoli storage life (21-28 days). Heads stored at 5°C (41°F) can have a storage life of 14 days; storage life at 10°C (50°F) is about 5 days. Broccoli is usually rapidly cooled by liquid-icing the field-packed waxed cartons. Hydrocooling and forced-air cooling also can be used, but temperature management during distribution is more critical than with iced broccoli.

FREEZING INJURY

Broccoli will freeze if stored at -0.6°C (30.6°F) to -1.0°C (30°F). This may also occur if salt is used in the liquid-ice cooling slurry. Frozen and thawed areas on the florets appear very dark and translucent, may discolor after thawing and are very susceptible to bacterial decay.

RATES OF RESPIRATION

Broccoli heads have relatively high respiration rates:

Temperature	0°C (32°F)	5°C (41°F)	10°C (50°F)	15°C (59°F)	20°C (68°F)
ml CO_2/kg·hr	10-11	16-18	38-43	80-90	140-160

The respiration rates of florets are slightly more than twice the rates of the intact heads.

To calculate heat of production multiply ml CO_2/kg·hr by 440 to get Btu/ton/day or by 122 to get kcal/metric ton/day.

RATES OF ETHYLENE PRODUCTION

Very low, <0.1 µL/kg·h at 20°C (68°F).

RESPONSES TO ETHYLENE

Broccoli is extremely sensitive to exposure to ethylene. Floret yellowing is the most common symptom. Exposure to 2 ppm ethylene at 10°C (50°F) reduces shelf-life by 50%.

RESPONSES TO CONTROLLED ATMOSPHERES (CA)

Broccoli can be benefitted by 1-2% O_2 with 5-10% CO_2 atmospheres at a temperature range of 0-5°C (32-41°F). Although under controlled conditions such low O_2 levels extend shelf-life, temperature fluctuations during commercial handling make this risky as broccoli can easily produce offensive sulfur-containing volatiles. As a result, a high rate of air exchange is recommended in standard marine container shipments of broccoli. Most modified atmosphere packaging for broccoli is designed to maintain O_2 at 3-10% and CO_2 at about 7-10% to avoid the development of these undesirable off-odor volatiles.

PHYSIOLOGICAL DISORDERS

Hollow stem is an open area in the stem at the cut surface which may become discolored and decay; growing conditions and variety selection affect development of this disorder.

Floret (bead) yellowing. The florets are the most perishable part of the broccoli head; yellowing may be due to overmaturity at harvest, high storage temperatures, and/or exposure to ethylene. Any development of yellow beads ends commercial marketability. Bead yellowing due to senescence should not be confused with the yellow-light green color of areas of florets not exposed to light during growth, sometimes called "marginal yellowing".

Brown floret (bead) is a disorder in which areas of florets do not develop correctly, die and lead to brown discolored areas. This is thought to be caused by plant nutritional imbalances.

PATHOLOGICAL DISORDERS

Bacterial decay. Various soft-rot causing organisms (Erwinia, Pseudomonas) may affect broccoli shelf-life. Rots due to these organisms are usually associated with physical injury.

Fungal pathogens. Although not as common as bacterial rots, Gray Mold Rot (*Botrytis cinerea*) and black mold (*Alternaria* spp.) can infect broccoli heads; this may occur under rainy, very cool growing conditions.

PHYSICAL DISORDERS

Rough handling at harvest can damage the florets and increase decay. The force used to apply the water-ice slurry for cooling can also damage the florets on the heads and increase susceptibility to bacterial decay.

SPECIAL CONSIDERATIONS

Storage life varies considerably among broccoli cultivars. Shelf-life (appearance of any yellow beads = end of shelf-life) may vary from 12 to >25 days depending on cultivar: Shelf-life of different broccoli cultivars stored at 5°C (41°F), and 95% RH:

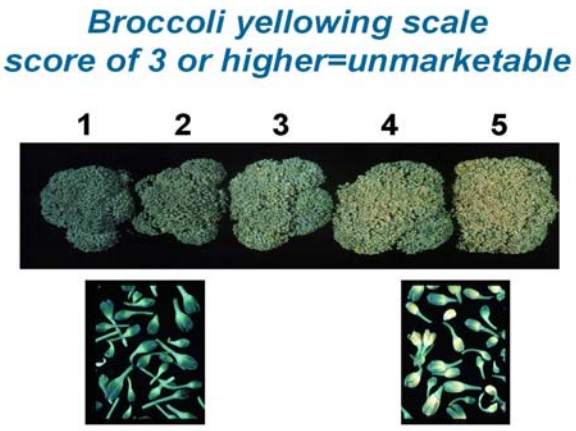
Short (<20 Days): Baccus, Brigadier, Cruiser, Mariner, Symphony, Zeus

Moderate (20 to 25 days): Cascade, Embassy, Emperor, Esquire, Galaxy, Gem, Green Lady, Green Valiant, Hi Caliber, Midori #8, Pinnacle, Sakata #12, Schooner, Southern Comet, Vantage

Long (>25 days): Citation, Galaxy, Glacier, Greenbelt, Legacy, Marathon, Mercedes, Packman, Pirate, Premium Crop, Shogun, Skiff

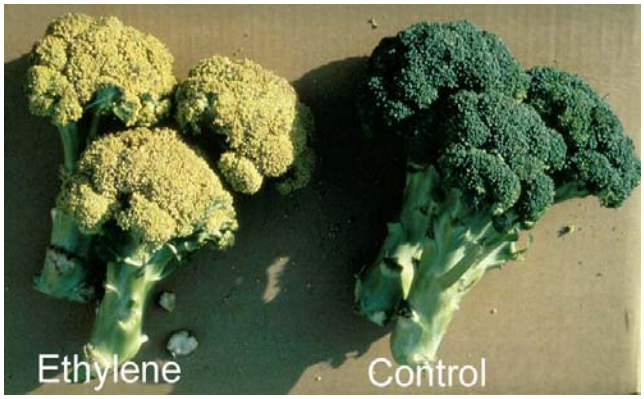
POSTHARVEST PHOTO GUIDE

RESPONSES TO CONTROLLED ATMOSPHERES (CA)



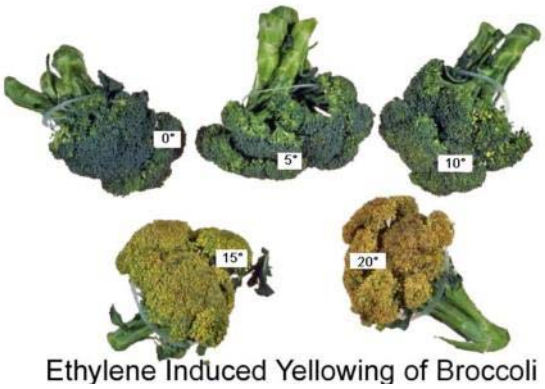
YELLOW SCALING

RATES OF ETHYLENE PRODUCTION



ETHYLENE YELLOWING

PHYSICAL DISORDERS



ETHYLENE YELLOWING

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Broccoli Produce Facts
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